

# X3 Frequency Multiplier

RMK-3-212+

50Ω      Output 1200 to 2100 MHz



CASE STYLE: TT1224

## The Big Deal

- Wide bandwidth, 1200 to 2100 MHz output
- Wide input power range, +12 to +17 dBm
- Low conversion loss, 14 dB typ.
- Good harmonic suppression: F2, 50 dBc; F4, 53 dBc

## Product Overview

Mini-Circuits' RMK-3-212+ frequency multiplier provides a multiplication factor of 3, converting input frequencies from 400 to 700 MHz into output frequencies from 1200 to 2100 MHz, supporting applications such as synthesizers, local oscillators, satellite up and down converters and more. The unit provides an input power range from +12 to +17 dBm, low conversion loss of 14 dB and good harmonic suppression. The multiplier comes housed in a miniature, surface-mount package (0.25 x 0.31 x 0.16") ideal for dense circuit board layouts.

| Feature                                                                                                          | Advantages                                                                                                            |
|------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Low conversion loss, 14 dB typ.                                                                                  | With a low conversion loss, the unit produces higher output power, reducing the need for amplification.               |
| Very good harmonic suppression <ul style="list-style-type: none"><li>• F2, 50 dBc</li><li>• F4, 53 dBc</li></ul> | Reduces spurious signals and the need for additional filtering.                                                       |
| Wide bandwidth                                                                                                   | With an output frequency range spanning 1200 to 2100 MHz, this multiplier covers a wide range of applications.        |
| Wide input power range, +12 to +17 dBm                                                                           | Wide input power signal range accommodates different input signal levels while still maintaining low conversion loss. |
| Low cost                                                                                                         | Provides an easy, cost-effective solution for generating high-frequency signals from a lower frequency signal source. |
| Small size                                                                                                       | Measuring only 0.25 x 0.31 x 0.16", the RMK-3-212+ saves space in crowded PCB layouts.                                |

### Notes

- A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.  
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.  
C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at [www.minicircuits.com/MCLStore/terms.jsp](http://www.minicircuits.com/MCLStore/terms.jsp)



# X3 Frequency Multiplier

50Ω Output 1200 to 2100 MHz

RMK-3-212+

## Maximum Ratings

|                                                                 |                |
|-----------------------------------------------------------------|----------------|
| Operating Temperature                                           | -40°C to 85°C  |
| Storage Temperature                                             | -55°C to 100°C |
| RF Input Power                                                  | 20 dBm         |
| Permanent damage may occur if any of these limits are exceeded. |                |

## Pin Connections

|        |         |
|--------|---------|
| INPUT  | 1       |
| OUTPUT | 4       |
| GROUND | 2,3,5,6 |

## Features

- broadband
- low conversion loss, 14 dB typ.
- high rejection F2, 50 dBc typ; F4, 53 dBc typ
- low cost
- aqueous washable

## Applications

- synthesizers
- local oscillators
- satellite up and down converters



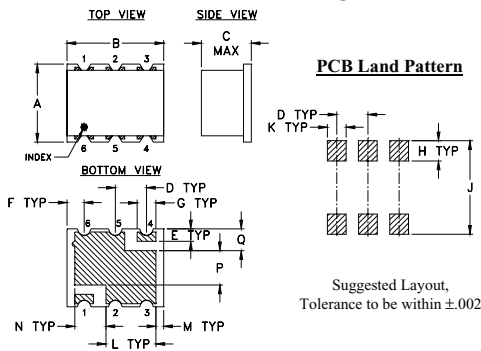
Generic photo used for illustration purposes only  
CASE STYLE: TT1224

### +RoHS Compliant

The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

| Reel Size | Devices/Reel         |
|-----------|----------------------|
| 7"        | 10, 20, 50, 100, 200 |
| 13"       | 500                  |

## Outline Drawing



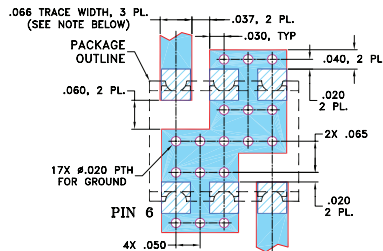
### PCB Land Pattern

Suggested Layout,  
Tolerance to be within ±.002

## Outline Dimensions (inch)

| A    | B    | C    | D    | E    | F    | G    | H     |
|------|------|------|------|------|------|------|-------|
| .25  | .31  | .16  | .100 | .040 | .055 | .060 | .065  |
| 6.35 | 7.87 | 4.06 | 2.54 | 1.02 | 1.40 | 1.52 | 1.65  |
| J    | K    | L    | M    | N    | P    | Q    | wt.   |
| .300 | .060 | .160 | .025 | .100 | .110 | .070 | grams |
| 7.62 | 1.52 | 4.06 | 0.64 | 2.54 | 2.79 | 1.78 | 0.16  |

## Demo Board MCL P/N: TB-393 Suggested PCB Layout (PL-258)



- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .030" ± .002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.  
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.  
3. DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)  
4. DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

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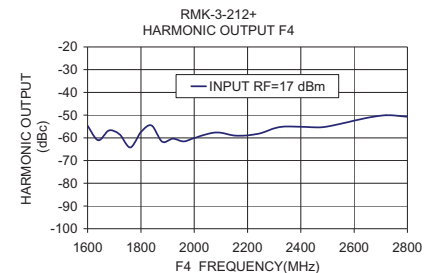
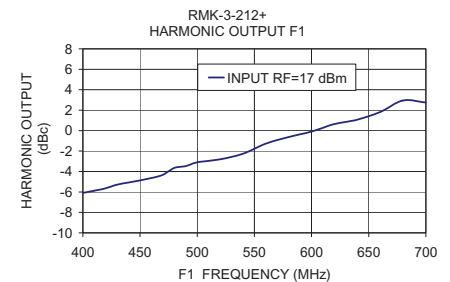
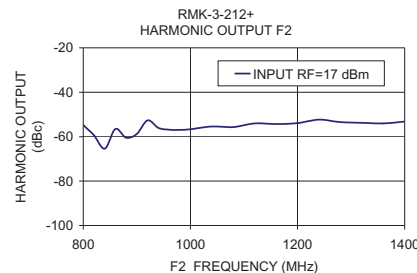
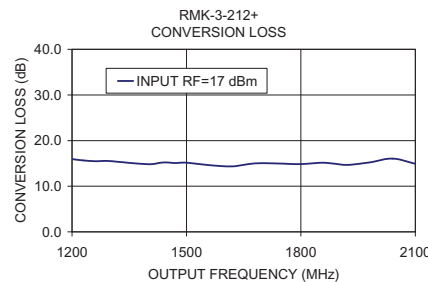
## Electrical Specifications at 25°C

| Parameter                    | Min. | Typ. | Max. | Unit |
|------------------------------|------|------|------|------|
| Multiplier Factor            |      | 3    |      |      |
| Frequency Range, Input (F1)  | 400  | —    | 700  | MHz  |
| Frequency Range, Output (F3) | 1200 | —    | 2100 | MHz  |
| Input Power                  | 12   | —    | 17   | dBm  |
| Conversion Loss              |      | 14   | 19   | dB   |
| Harmonic Output*             | F1   | -10  | -1.4 | —    |
|                              | F2   | 33   | 50   | —    |
|                              | F4   | 30   | 53   | —    |

\* Harmonics of input frequency below the power level of F3

## Typical Performance Data

| Frequency      |                 | Conv. Loss<br>(dB)<br>F3 | Harmonic Rejection Below F3, (dBc)<br>at RF Input Power 17 dBm |        |        |
|----------------|-----------------|--------------------------|----------------------------------------------------------------|--------|--------|
| Input<br>(MHz) | Output<br>(MHz) |                          | F1                                                             | F2     | F4     |
| 400.00         | 1200.00         | 15.96                    | -6.10                                                          | -54.79 | -54.66 |
| 420.00         | 1260.00         | 15.48                    | -5.64                                                          | -65.42 | -56.75 |
| 450.00         | 1350.00         | 15.10                    | -4.87                                                          | -58.81 | -57.48 |
| 500.00         | 1500.00         | 15.14                    | -3.10                                                          | -56.70 | -60.08 |
| 540.00         | 1620.00         | 14.36                    | -2.26                                                          | -55.71 | -59.08 |
| 600.00         | 1800.00         | 14.85                    | -0.09                                                          | -53.88 | -55.14 |
| 620.00         | 1860.00         | 15.16                    | 0.64                                                           | -52.35 | -55.34 |
| 640.00         | 1920.00         | 14.68                    | 1.07                                                           | -53.47 | -53.53 |
| 660.00         | 1980.00         | 15.22                    | 1.82                                                           | -53.78 | -51.42 |
| 700.00         | 2100.00         | 14.91                    | 2.75                                                           | -53.19 | -50.71 |



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REV. A  
M151107  
ED-14685/1  
RMK-3-212+  
AV/CP/AM  
200813  
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# Frequency Multiplier (Tripler)

RMK-3-212+

## Typical Performance Data

| FREQUENCY<br>(MHz) |           |           |           | CONVERSION<br>LOSS<br>(dB) | RF IN = +12 dBm<br>HARMONIC OUTPUT*<br>(-dBc) |           |           |
|--------------------|-----------|-----------|-----------|----------------------------|-----------------------------------------------|-----------|-----------|
| X1 OUTPUT          | X2 OUTPUT | X3 OUTPUT | X4 OUTPUT |                            | X1 OUTPUT                                     | X2 OUTPUT | X4 OUTPUT |
| 375.0              | 750.0     | 1125.0    | 1500.0    | 13.87                      | 5.36                                          | 42.64     | 41.16     |
| 380.0              | 760.0     | 1140.0    | 1520.0    | 13.70                      | 5.30                                          | 42.35     | 40.63     |
| 385.0              | 770.0     | 1155.0    | 1540.0    | 13.45                      | 5.27                                          | 48.87     | 49.92     |
| 390.0              | 780.0     | 1170.0    | 1560.0    | 13.51                      | 4.99                                          | 52.22     | 56.37     |
| 395.0              | 790.0     | 1185.0    | 1580.0    | 13.65                      | 4.69                                          | 55.03     | 64.34     |
| 400.0              | 800.0     | 1200.0    | 1600.0    | 13.90                      | 4.33                                          | 58.54     | 61.14     |
| 410.0              | 820.0     | 1230.0    | 1640.0    | 14.83                      | 3.12                                          | 76.86     | 51.07     |
| 420.0              | 840.0     | 1260.0    | 1680.0    | 14.31                      | 3.19                                          | 48.56     | 45.43     |
| 430.0              | 860.0     | 1290.0    | 1720.0    | 13.69                      | 3.25                                          | 52.56     | 61.49     |
| 440.0              | 880.0     | 1320.0    | 1760.0    | 13.23                      | 3.22                                          | 58.45     | 58.99     |
| 450.0              | 900.0     | 1350.0    | 1800.0    | 13.14                      | 2.97                                          | 60.21     | 55.85     |
| 460.0              | 920.0     | 1380.0    | 1840.0    | 13.73                      | 2.23                                          | 55.69     | 60.67     |
| 470.0              | 940.0     | 1410.0    | 1880.0    | 14.56                      | 1.14                                          | 50.38     | 57.74     |
| 480.0              | 960.0     | 1440.0    | 1920.0    | 15.07                      | 0.21                                          | 52.60     | 52.39     |
| 490.0              | 980.0     | 1470.0    | 1960.0    | 13.56                      | 1.14                                          | 55.07     | 53.55     |
| 500.0              | 1000.0    | 1500.0    | 2000.0    | 12.92                      | 1.29                                          | 55.39     | 53.35     |
| 520.0              | 1040.0    | 1560.0    | 2080.0    | 12.49                      | 0.97                                          | 53.40     | 52.77     |
| 540.0              | 1080.0    | 1620.0    | 2160.0    | 14.07                      | -0.92                                         | 54.39     | 51.85     |
| 560.0              | 1120.0    | 1680.0    | 2240.0    | 13.81                      | -1.41                                         | 54.88     | 52.02     |
| 580.0              | 1160.0    | 1740.0    | 2320.0    | 13.03                      | -1.42                                         | 54.56     | 51.27     |
| 600.0              | 1200.0    | 1800.0    | 2400.0    | 13.26                      | -2.20                                         | 55.45     | 50.85     |
| 620.0              | 1240.0    | 1860.0    | 2480.0    | 13.21                      | -2.70                                         | 54.73     | 50.18     |
| 640.0              | 1280.0    | 1920.0    | 2560.0    | 12.78                      | -3.00                                         | 56.44     | 49.77     |
| 660.0              | 1320.0    | 1980.0    | 2640.0    | 13.82                      | -4.31                                         | 58.17     | 49.01     |
| 680.0              | 1360.0    | 2040.0    | 2720.0    | 14.16                      | -5.19                                         | 60.35     | 48.50     |
| 700.0              | 1400.0    | 2100.0    | 2800.0    | 12.94                      | -4.69                                         | 58.33     | 48.77     |
| 710.0              | 1420.0    | 2130.0    | 2840.0    | 13.57                      | -5.45                                         | 60.50     | 48.39     |
| 720.0              | 1440.0    | 2160.0    | 2880.0    | 14.87                      | -6.74                                         | 60.74     | 48.05     |
| 730.0              | 1460.0    | 2190.0    | 2920.0    | 15.23                      | -7.34                                         | 59.21     | 47.46     |
| 740.0              | 1480.0    | 2220.0    | 2960.0    | 14.65                      | -7.13                                         | 58.08     | 47.69     |
| 750.0              | 1500.0    | 2250.0    | 3000.0    | 12.76                      | -5.85                                         | 54.62     | 48.21     |
| 760.0              | 1520.0    | 2280.0    | 3040.0    | 10.90                      | -4.71                                         | 56.53     | 46.52     |
| 770.0              | 1540.0    | 2310.0    | 3080.0    | 13.34                      | -6.69                                         | 54.16     | 47.00     |
| 780.0              | 1560.0    | 2340.0    | 3120.0    | 15.69                      | -8.73                                         | 52.47     | 47.45     |

\* Harmonic Output below power level of X3 Output.

| FREQUENCY<br>(MHz) |           |           |           | CONVERSION<br>LOSS<br>(dB) | RF IN = +17dBm<br>HARMONIC OUTPUT*<br>(-dBc) |           |           |
|--------------------|-----------|-----------|-----------|----------------------------|----------------------------------------------|-----------|-----------|
| X1 OUTPUT          | X2 OUTPUT | X3 OUTPUT | X4 OUTPUT |                            | X1 OUTPUT                                    | X2 OUTPUT | X4 OUTPUT |
| 375.0              | 750.0     | 1125.0    | 1500.0    | 16.62                      | 6.61                                         | 52.96     | 47.32     |
| 380.0              | 760.0     | 1140.0    | 1520.0    | 16.70                      | 6.35                                         | 39.18     | 34.22     |
| 385.0              | 770.0     | 1155.0    | 1540.0    | 16.41                      | 6.35                                         | 44.73     | 40.96     |
| 390.0              | 780.0     | 1170.0    | 1560.0    | 16.26                      | 6.25                                         | 49.23     | 46.30     |
| 395.0              | 790.0     | 1185.0    | 1580.0    | 16.09                      | 6.17                                         | 52.34     | 50.89     |
| 400.0              | 800.0     | 1200.0    | 1600.0    | 15.96                      | 6.10                                         | 54.79     | 54.66     |
| 410.0              | 820.0     | 1230.0    | 1640.0    | 15.65                      | 5.87                                         | 59.35     | 61.06     |
| 420.0              | 840.0     | 1260.0    | 1680.0    | 15.48                      | 5.64                                         | 65.42     | 56.75     |
| 430.0              | 860.0     | 1290.0    | 1720.0    | 15.53                      | 5.28                                         | 56.57     | 58.46     |
| 440.0              | 880.0     | 1320.0    | 1760.0    | 15.36                      | 5.07                                         | 60.52     | 64.22     |
| 450.0              | 900.0     | 1350.0    | 1800.0    | 15.10                      | 4.87                                         | 58.81     | 57.48     |
| 460.0              | 920.0     | 1380.0    | 1840.0    | 14.91                      | 4.64                                         | 52.63     | 54.54     |
| 470.0              | 940.0     | 1410.0    | 1880.0    | 14.83                      | 4.32                                         | 56.01     | 61.72     |
| 480.0              | 960.0     | 1440.0    | 1920.0    | 15.22                      | 3.65                                         | 56.90     | 60.35     |
| 490.0              | 980.0     | 1470.0    | 1960.0    | 15.07                      | 3.47                                         | 56.95     | 61.55     |
| 500.0              | 1000.0    | 1500.0    | 2000.0    | 15.14                      | 3.10                                         | 56.70     | 60.08     |
| 520.0              | 1040.0    | 1560.0    | 2080.0    | 14.60                      | 2.80                                         | 55.45     | 57.67     |
| 540.0              | 1080.0    | 1620.0    | 2160.0    | 14.36                      | 2.26                                         | 55.71     | 59.08     |
| 560.0              | 1120.0    | 1680.0    | 2240.0    | 15.00                      | 1.27                                         | 54.06     | 58.24     |
| 580.0              | 1160.0    | 1740.0    | 2320.0    | 14.97                      | 0.63                                         | 54.32     | 55.26     |
| 600.0              | 1200.0    | 1800.0    | 2400.0    | 14.85                      | 0.09                                         | 53.88     | 55.14     |
| 620.0              | 1240.0    | 1860.0    | 2480.0    | 15.16                      | -0.64                                        | 52.35     | 55.34     |
| 640.0              | 1280.0    | 1920.0    | 2560.0    | 14.68                      | -1.07                                        | 53.47     | 53.53     |
| 660.0              | 1320.0    | 1980.0    | 2640.0    | 15.22                      | -1.82                                        | 53.78     | 51.42     |
| 680.0              | 1360.0    | 2040.0    | 2720.0    | 16.05                      | -2.94                                        | 54.02     | 50.03     |
| 700.0              | 1400.0    | 2100.0    | 2800.0    | 14.91                      | -2.75                                        | 53.19     | 50.71     |
| 710.0              | 1420.0    | 2130.0    | 2840.0    | 15.33                      | -3.27                                        | 53.45     | 51.21     |
| 720.0              | 1440.0    | 2160.0    | 2880.0    | 16.46                      | -4.24                                        | 52.47     | 49.75     |
| 730.0              | 1460.0    | 2190.0    | 2920.0    | 16.83                      | -4.76                                        | 52.68     | 52.34     |
| 740.0              | 1480.0    | 2220.0    | 2960.0    | 16.40                      | -4.73                                        | 53.38     | 48.57     |
| 750.0              | 1500.0    | 2250.0    | 3000.0    | 14.98                      | -4.10                                        | 53.77     | 48.07     |
| 760.0              | 1520.0    | 2280.0    | 3040.0    | 13.86                      | -4.11                                        | 49.64     | 53.06     |
| 770.0              | 1540.0    | 2310.0    | 3080.0    | 15.48                      | -4.74                                        | 55.39     | 45.82     |
| 780.0              | 1560.0    | 2340.0    | 3120.0    | 17.15                      | -6.11                                        | 54.35     | 46.65     |

\* Harmonic Output below power level of X3 Output.

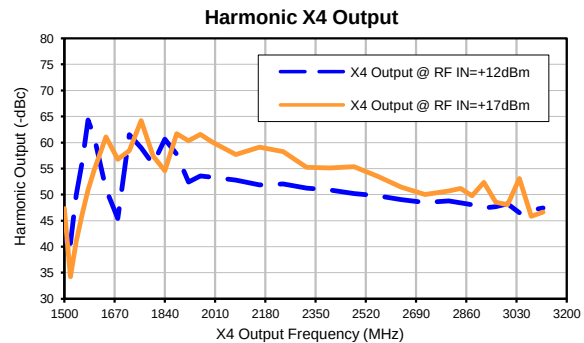
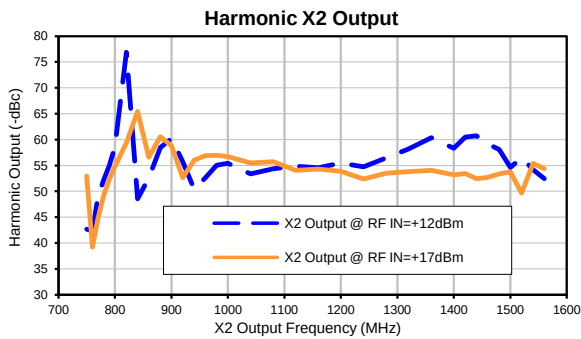
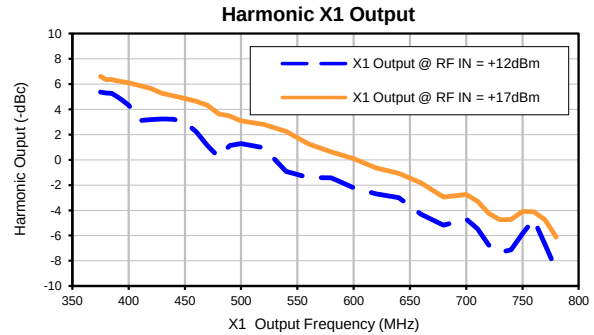
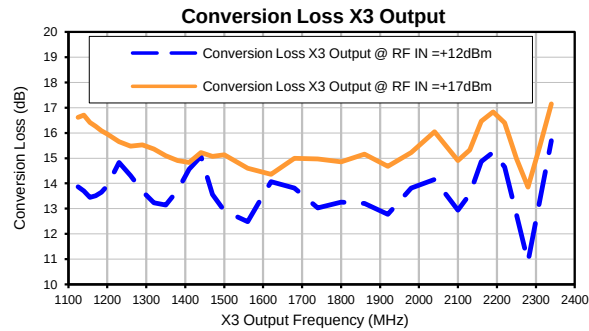


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The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

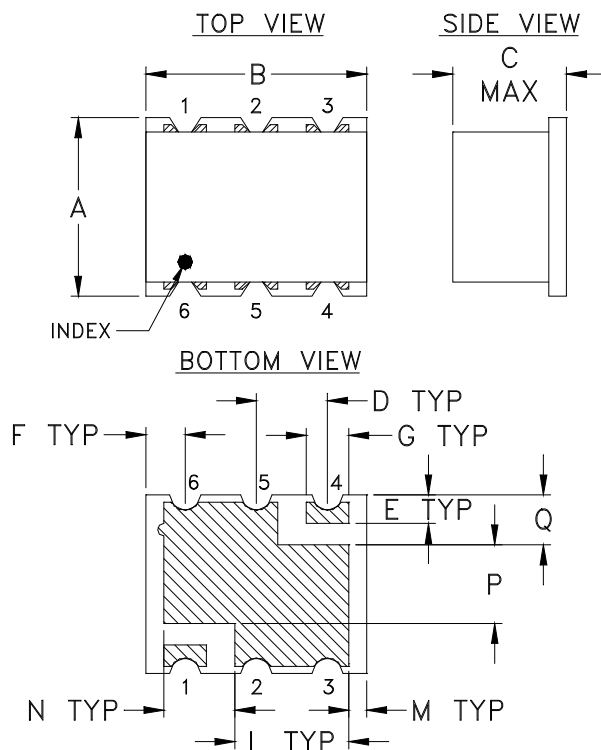
IF/RF MICROWAVE COMPONENTS

REV. OR  
RMK-3-212+  
2/2/2015  
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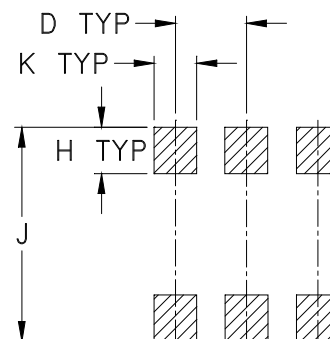
## Typical Performance Curves



### Outline Dimensions



### PCB Land Pattern



Suggested Layout,  
Tolerance to be within  $\pm .002$

| CASE # | A             | B             | C             | D              | E              | F              | G              | H              | J              | K              | L              |
|--------|---------------|---------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| TT1224 | .25<br>(6.35) | .31<br>(7.87) | .16<br>(4.06) | .100<br>(2.54) | .040<br>(1.02) | .055<br>(1.40) | .060<br>(1.52) | .065<br>(1.65) | .300<br>(7.62) | .060<br>(1.52) | .160<br>(4.06) |

| CASE # | M             | N              | P              | Q              | WT. GRAM |
|--------|---------------|----------------|----------------|----------------|----------|
| TT1224 | .025<br>(.64) | .100<br>(2.54) | .110<br>(2.79) | .070<br>(1.78) | .16      |

Dimensions are in inches (mm). Tolerances: 2Pl.  $\pm .01$ ; 3 Pl.  $\pm .005$

### Notes:

- Case material: Plastic.
- Termination: 2-10  $\mu$  inch (.05-.25 microns) Gold over 100-300  $\mu$  inch (2.54-7.62 microns) Nickel plate



P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site

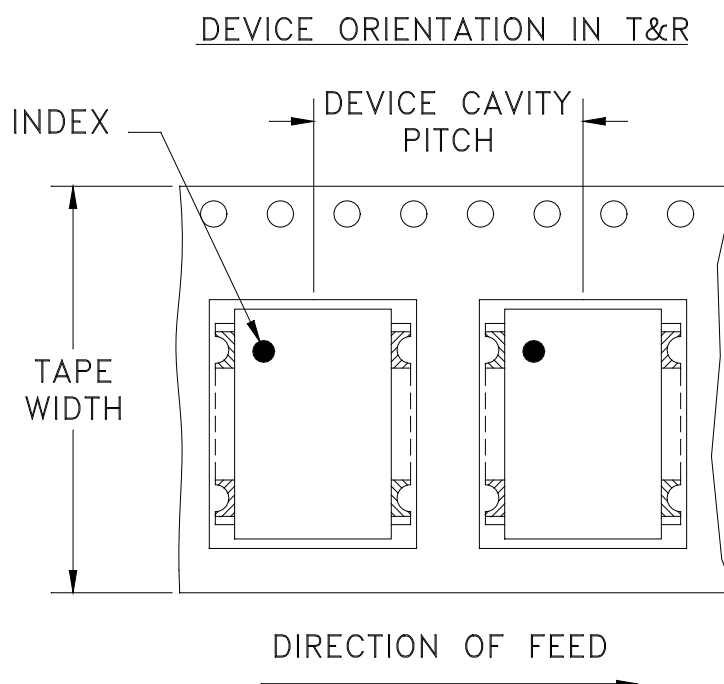


Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

RF/IF MICROWAVE COMPONENTS



# *Tape & Reel Packaging TR-F2*



| Tape Width, mm | Device Cavity Pitch, mm | Reel Size, inches | Devices per Reel<br>See note |
|----------------|-------------------------|-------------------|------------------------------|
| 16             | 12                      | 7                 | 10                           |
|                |                         |                   | 20                           |
|                |                         |                   | 50                           |
|                |                         |                   | 100                          |
|                |                         |                   | 200                          |
|                |                         | 13                | 500                          |
|                |                         |                   | 1000                         |

Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

Go to: [www.minicircuits.com/pages/pdfs/tape.pdf](http://www.minicircuits.com/pages/pdfs/tape.pdf)



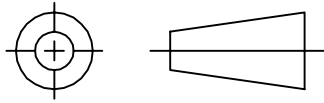
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## THIRD ANGLE PROJECTION

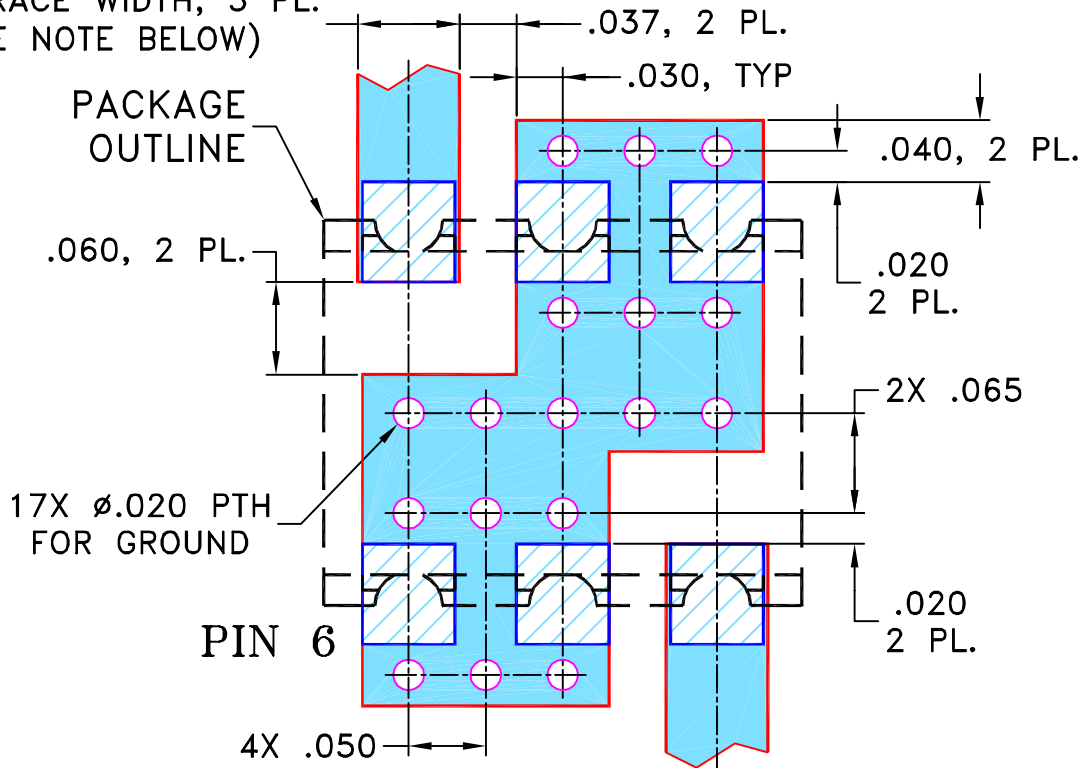


## REVISIONS

| REV | ECN No. | DESCRIPTION | DATE     | DR | AUTH |
|-----|---------|-------------|----------|----|------|
| OR  | M108897 | NEW RELEASE | 01/04/07 | AV | DJ   |
|     |         |             |          |    |      |
|     |         |             |          |    |      |

### SUGGESTED MOUNTING CONFIGURATION FOR TT1224 CASE STYLE "rv" PIN CONNECTION

.066 TRACE WIDTH, 3 PL.  
(SEE NOTE BELOW)



- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS .030"  $\pm$  .002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.



DENOTES PCB COPPER LAYOUT WITH SMOBC  
(SOLDER MASK OVER BARE COPPER)



DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

UNLESS OTHERWISE SPECIFIED

INITIALS

DATE

DIMENSIONS ARE IN INCHES

DRAWN

AV

12/14/06

TOLERANCES ON:

CHECKED

IL

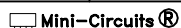
01/04/07

2 PL DECIMALS  $\pm$ 

APPROVED

DJ

01/04/07

3 PL DECIMALS  $\pm$  .005ANGLES  $\pm$ FRACTIONS  $\pm$ 

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ASHEETA1.DWG REV:A DATE:01/12/95



## Mini-Circuits®

13 Neptune Avenue  
Brooklyn NY 11235

### PL, rv, TT1224, RMK-3-662+, TB-393

SIZE  
A

CODE IDENT  
15542

DRAWING NO:  
98-PL-258

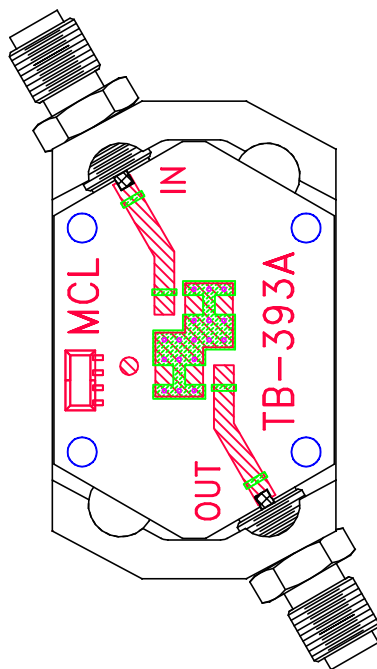
REV:  
OR

FILE: 98PL258

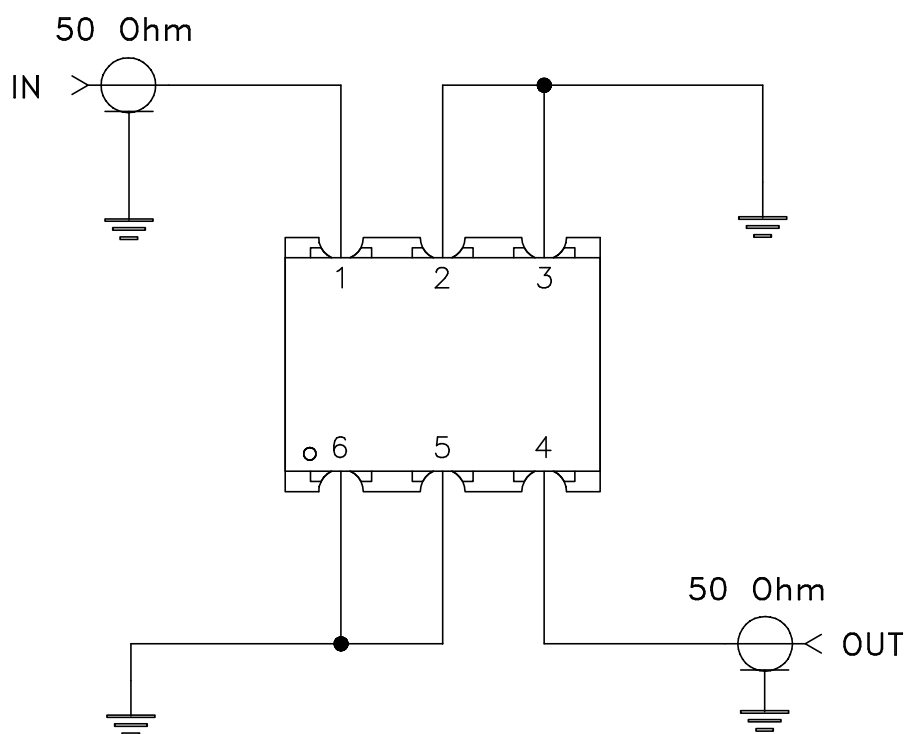
SCALE: 8:1

SHEET: 1 OF 1

# Evaluation Board and Circuit



TB-393



Schematic Diagram

## Notes:

1. SMA Female connectors.
2. PCB Material: Rogers R04350 or equivalent,  
Dielectric Constant=3.5, Thickness=.030 inch.

 Mini-Circuits®





All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

| Specification                  | Test/Inspection Condition                                                                                                                                       | Reference/Spec                                                                                       |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| Operating Temperature          | -40° to 85°C<br>Ambient Environment                                                                                                                             | Individual Model Data Sheet                                                                          |
| Storage Temperature            | -55° to 100° C<br>Ambient Environment                                                                                                                           | Individual Model Data Sheet                                                                          |
| Humidity                       | 90 to 95% RH, 240 hours, 50°C                                                                                                                                   | MIL-STD-202, Method 103, Condition A, Except 50°C and end-point electrical test done within 12 hours |
| Thermal Shock                  | -55° to 100°C, 100 cycles                                                                                                                                       | MIL-STD-202, Method 107, Condition A-3, except +100°C                                                |
| Solder Reflow Heat             | Sn-Pb Eutetic Process: 225°C peak<br>Pb-Free Process 245° - 250°C peak                                                                                          | J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1                                                        |
| Solderability                  | 10X Magnification                                                                                                                                               | J-STD-002, 95% Coverage                                                                              |
| Vibration (High Frequency)     | 20g peak, 10-2000 Hz, 12 times in each of three perpendicular directions (total 36)                                                                             | MIL-STD-202, Method 204, Condition D                                                                 |
| Mechanical Shock               | 50g, 11 ms, 1/2-sine, 18 shocks: 3 each direction, each of 3 axes                                                                                               | MIL-STD-202, Method 213, Condition A                                                                 |
| Marking Resistance to Solvents | Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C;<br>distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C | MIL-STD-202, Method 215                                                                              |